Trend Analysis and Ten-Year Forecast of Incidence, Prevalence, and Mortality of Chronic Obstructive Pulmonary Disease in China, 1990-2021: A Postprint Study

Authors: Chen Xueqin, Wang Shihong, Lai Fengxia, Zhang Jingjing, Chen Hao, Kong Danli, Ding Yuanlin, Ding Yuanlin

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Abstract

Background Chronic obstructive pulmonary disease (hereinafter referred to as COPD) has a complex pathogenesis, and analyzing and predicting its epidemic status can provide certain references for the prevention and control of COPD. Objective To understand the incidence, prevalence, and mortality of COPD in China from 1990 to 2021, and to predict its incidence and mortality rates from 2022 to 2032, providing references for the prevention and treatment of COPD. Methods Based on the Global Burden of Disease Study 2021 (GBD 2021), data on the incidence, prevalence, and mortality of COPD in China from 1990 to 2021 were collected. The changing trends of COPD in China were analyzed according to the change rate (%) and estimated annual percentage change (EAPC). The autoregressive integrated moving average (ARIMA) model was used to predict the incidence, prevalence, and mortality rates of COPD in China from 2022 to 2032. Results From 1990 to 2021, the standardized incidence and prevalence rates of COPD in the entire Chinese population showed an upward trend (EAPC=2.25% and 2.53%, respectively; t-values=71.35 and 165.91, respectively; P<0.001); whereas the standardized mortality rate showed a downward trend compared with 1990 (EAPC=-0.31%, P<0.05). In 2021, the standardized incidence rate of COPD among Chinese males was 308.68/100,000, and the prevalence rate was 3,358.06/100,000; compared with 1990, both the standardized incidence and prevalence rates of COPD in males showed an upward trend (EAPC=2.32% and 2.48%, respectively; t-values=64.23 and 39.67, respectively; P<0.001); while the standardized mortality rate in males increased from 97.13/100,000 to 101.05/100,000, but the trend was not statistically significant (EAPC=0.05%, t=0.62, P=0.54). In 2021, the standardized incidence rate of COPD among Chinese females was 320.70/100,000, and the standardized

prevalence rate was 3,829.79/100,000; compared with 1990, both the standardized incidence and prevalence rates of COPD in females showed an upward trend (EAPC=2.19% and 2.59%, respectively; t-values=25.29 and 33.19, respectively; P<0.001); the standardized mortality rate in females showed a downward trend (EAPC=-0.77%, t=-3.36, P<0.01), decreasing from 91.43/100,000 in 1990 to 74.18/100,000. In 2021, the standardized incidence and prevalence rates of COPD among Chinese females were 1.04 and 1.14 times those of males, respectively; the standardized mortality rate of COPD among males was 1.36 times that of females. In age-stratified analysis, the 25–29 age group showed a weak but statistically significant increasing trend in standardized incidence rate (EAPC=0.05%, P<0.01), while the standardized incidence rate in the 30–44 age group fluctuated without reaching statistical significance (P>0.05). The population aged 50 years and above showed an increasing trend in standardized incidence rate, with the magnitude of increase further expanding with age, among which the $ $80 age group had the highest increase (EAPC=4.46%, t=89.92, P<0.001). The age-stratified trend in COPD prevalence showed significant divergence: the prevalence rate in the 25–34 age group decreased significantly (25–29 years: EAPC=-1.52%, P<0.001; 30–34 years: EAPC=-0.57%, P=0.045), the change in prevalence in the 35–39 age group did not reach statistical significance (EAPC=-0.4%, P=0.187), while the 40–44 age group showed a turning point increase (EAPC=0.60%, P=0.047), and the population aged 50 years and above demonstrated a rapid upward trend (EAPC>1%, P<0.001). COPD mortality showed the following pattern: the $ $80 age group exhibited a significant upward trend in COPD mortality (EAPC=0.95%, P<0.001); the COPD mortality rate in age groups below 80 years continued to decline (EAPC<-0.5%, P<0.001). The ARIMA model prediction results showed that from 2022 to 2032, the incidence and prevalence rates of COPD in China would show an upward trend, with overall mortality declining, but male mortality showing an upward trend, while female mortality would fluctuate but show an overall downward trend. The incidence rate of COPD in 2032 is projected to reach 409.39/100,000, and the prevalence rate is projected to reach 4,675.48/100,000. In 2032, the mortality rate in the entire population is projected to reach 71.39/100,000, the mortality rate in the male population is projected to reach 112.10/100,000, and the mortality rate in the female population is projected to reach 77.32/100,000. Conclusion From 1990 to 2021, the standardized incidence and prevalence rates of COPD in the entire Chinese population, male population, and female population showed an overall upward trend. In the elderly population, the standardized incidence and prevalence rates of COPD showed an increasing trend, the mortality rate in the population aged 80 years and above showed an upward trend, while the COPD mortality rate in the population below 80 years showed a downward trend. From 2022 to 2032, the incidence and prevalence rates of COPD in China are projected to show an upward trend, with overall mortality declining, but male mortality showing an upward trend, while female mortality will fluctuate but show an overall downward trend.

Full Text

Study on Trend Analysis and Forecast of Incidence, Prevalence, and Mortality of Chronic Obstructive Pulmonary Disease in China, 1990-2021

CHEN Xueqin, WANG Shihong, LAI Fengxia, ZHANG Jingjing, CHEN Hao, KONG Danli, DING Yuanlin*

School of Public Health, Guangdong Medical University, Zhanjiang 524023, China

*Corresponding author: DING Yuanlin, Professor/Doctoral supervisor; E-mail: gdmusbd@gdmu.edu.cn

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Abstract

Background: The pathogenesis of chronic obstructive pulmonary disease (COPD) is complex. Analyzing and forecasting its epidemiological status can provide valuable insights for COPD prevention and control.

Objective: To examine COPD incidence, prevalence, and mortality in China from 1990 to 2021, and predict the incidence and mortality rates for 2022-2032 to inform COPD prevention and treatment efforts.

Methods: Based on the 2021 Global Burden of Disease (GBD) database, we collected incidence, prevalence, and mortality data for COPD in China from 1990 to 2021. Trends were analyzed using change rates (%) and estimated annual percentage change (EAPC). The autoregressive integrated moving average (ARIMA) model was used to predict COPD incidence, prevalence, and mortality in China from 2022 to 2032.

Results: From 1990 to 2021, the standardized incidence and prevalence of COPD in the entire Chinese population showed increasing trends (EAPC = 2.25% and 2.53%, respectively; t = 71.35 and 165.91, respectively; $P < 0.001$), while the standardized mortality rate showed a decreasing trend compared with 1990 (EAPC = -0.31%, $P < 0.05$). In 2021, the standardized incidence and prevalence of COPD in Chinese men were 308.68/100,000 and 3,358.06/100,000, respectively; both showed increasing trends compared with 1990 (EAPC = 2.32% and 2.48%, respectively; t = 64.23 and 39.67, respectively; $P < 0.001$). The standardized mortality rate in men increased from 97.13/100,000 to 101.05/100,000, but this trend was not statistically significant (EAPC = 0.05%, t = 0.62, P = 0.54). In 2021, the standardized incidence and prevalence of COPD in Chinese women were 320.70/100,000 and 3,829.79/100,000, respectively; both showed increasing trends compared with 1990 (EAPC = 2.19% and 2.59%, respectively; t = 25.29 and 33.19, respectively; $P < 0.001$). The standardized mortality rate in women showed a decreasing trend (EAPC = -0.77%, t = -3.36, $P < 0.01$), falling from 91.43/100,000 in

1990 to 74.18/100,000. In 2021, the standardized incidence and prevalence of COPD in Chinese women were 1.04 and 1.14 times higher than those in men, respectively, while the standardized mortality rate in men was 1.36 times higher than that in women. Age-stratified analysis revealed a weak but statistically significant increasing trend in the 25–29 age group (EAPC = 0.05%, P < 0.01), while incidence rates in the 30–44 age group fluctuated without reaching statistical significance (P > 0.05). The standardized incidence rate in populations over 50 years showed an increasing trend that intensified with age, with the most pronounced increase in the $ $80 age group (EAPC = 4.46%, t = 89.92, P < 0.001). The age-stratified trend of COPD prevalence showed significant differentiation: prevalence declined significantly in the 25–34 age group (25–29 years: EAPC = -1.52%, P < 0.001; 30–34 years: EAPC = -0.57%, P = 0.045), showed no statistically significant change in the 35–39 age group (EAPC = -0.4%, P = 0.187), increased transitionally in the 40–44 age group (EAPC = 0.60%, P = 0.047), and increased rapidly in those over 50 years (EAPC > 1%, P < 0.001). COPD mortality showed a significant upward trend in the $ $80 age group (EAPC = 0.95%, P < 0.001) but continued to decline in those under 80 years (all EAPC < -0.5%, P < 0.001). ARIMA model predictions indicated that COPD incidence and prevalence in China from 2022 to 2032 will show upward trends, while overall mortality will decline. However, male mortality will show an upward trend, whereas female mortality will fluctuate but generally decline. By 2032, COPD incidence is projected to reach 409.39/100,000, prevalence 4,675.48/100,000, overall mortality 71.39/100,000, male mortality 112.10/100,000, and female mortality 77.32/100,000.

Conclusion: From 1990 to 2021, the standardized incidence and prevalence of COPD in the entire Chinese population, as well as in men and women separately, showed overall increasing trends. In the elderly population, the standardized incidence and prevalence of COPD increased, with mortality rising in those aged 80 years and older while decreasing in those under 80. Predictions for 2022–2032 indicate that COPD incidence and prevalence will continue to rise, while overall mortality will decline. However, male mortality is expected to increase, whereas female mortality will fluctuate but show an overall decreasing trend.

Keywords: chronic obstructive pulmonary disease; incidence; prevalence; mortality; time series; trend prediction; ARIMA model

Introduction

Chronic obstructive pulmonary disease (COPD) is a common chronic respiratory disease characterized by persistent respiratory symptoms and airflow limitation. Its risk factors are diverse, and its pathogenesis is complex, potentially involving genetics, age, air pollutants, smoking, and occupational dust exposure. COPD severely impacts patients' quality of life and imposes a heavy economic burden on patients, families, and society. According to the Global Burden of Disease

(GBD) database, COPD was the fifth leading cause of death in China in 2016 and the third leading cause of disability-adjusted life years in 2017. The WHO predicts that COPD prevalence will continue to rise over the next 40 years due to increasing smoking rates in developing countries and population aging in high-income countries. Although China' s capacity and attention to COPD prevention and treatment have gradually improved, challenges remain, including inadequate primary-level prevention and treatment, non-standardized drug therapy, insufficient public knowledge about COPD, limited access to pulmonary function testing, and lack of standardized treatment protocols. Therefore, this study analyzes COPD incidence, prevalence, and mortality in China from 1990 to 2021 and establishes an autoregressive integrated moving average (ARIMA) model to predict trends from 2022 to 2032, providing a reference for targeted prevention and control measures.

Methods

1.1 Data Source Study data were obtained from the GBD 2021 database (https://vizhub.healthdata.org/gbd-results/). Established by the Institute for Health Metrics and Evaluation at the University of Washington, this database captures complex patterns of disease and injury burden across 204 countries and territories, covering 369 diseases and injuries with metrics including incidence, mortality, and disability-adjusted life years. This study retrieved data on COPD incidence, prevalence, and mortality in China from 1990 to 2021, with search parameters set to: region = China; year = 1990–2021; metrics = Number and Rate; indicators = Incidence, Prevalence, and Death; sex = All, Male, Female; and disease cause = chronic obstructive pulmonary disease (COPD).

1.2 Data Indicators We collected data on COPD cases and rates for incidence, prevalence, and mortality in China from 1990 to 2021. Data were processed by gender and age strata. To ensure comparability across different time points, direct standardization was applied using data from China' s seventh national population census as the standard population. Age-stratified analysis used 5-year intervals, creating 12 age groups: 25–29, 30–34, 35–39, 40–44, 45–49, 50–54, 55–59, 60–64, 65–69, 70–74, 75–79, and $ $80 years. All-age analysis covered all age groups to align with the original GBD database design and ensure comprehensive disease burden assessment.

1.3 Statistical Analysis Data were analyzed using SPSS 26.0, Excel 2021, and R 4.3.2. Change rates (%) and estimated annual percentage change (EAPC) were used to analyze trends in COPD incidence, prevalence, and mortality. The change rate (%) was calculated as: (2021 indicator value -1990 indicator value) / 1990 indicator value × 100%. EAPC (%) = 100 × (e$\widehat{\ }\alpha$ -1), where α is the regression coefficient from a simple linear regression equation with y representing the natural logarithm of COPD incidence, prevalence, or mortality rates and x representing year. Significance testing for EAPC used t-tests, with $P < 0.05$ considered statistically significant. The ARIMA time series model was

constructed in R 4.3.2 to predict COPD incidence, prevalence, and mortality in China from 2022 to 2032. The adf.test and Ljung-Box Q.test functions were used for unit root testing and white noise testing of the time series. The ARIMA model was built and used for data prediction, with residual sequences subjected to Ljung-Box Q.test white noise testing. If the test passed ($P > 0.05$), it indicated that the model had fully extracted sequence information and achieved good fit.

Results

2.1 Overall COPD Incidence and Mortality in China, 1990-2021 In 2021, COPD cases, prevalent cases, and deaths in China totaled 4.4344 million, 50.5884 million, and 1.2396 million, respectively. In 1990, these figures were 2.1610 million, 23.1450 million, and 1.3300 million, respectively. Compared with 1990, COPD cases increased by 105.20%, prevalent cases by 118.57%, and deaths decreased by 18.26% in 2021.

The standardized incidence and prevalence rates in 2021 were 307.20/100,000 and 3,504.57/100,000, respectively, representing increases of 105.20% and 118.57% compared with 1990. The standardized mortality rate decreased by 6.8% from 92.14/100,000 in 1990 to 85.88/100,000 in 2021. Compared with 1990, the standardized incidence and prevalence showed increasing trends (EAPC = 2.25% and 2.53%, respectively; t = 71.35 and 165.91, respectively; $P < 0.001$), while the standardized mortality rate showed a decreasing trend (EAPC = -0.31%, t = -2.31, $P < 0.05$) .

2.2 COPD Incidence and Mortality by Gender in China, 1990-2021 In 2021, COPD cases, prevalent cases, and deaths among Chinese men were 2.2268 million, 24.2256 million, and 0.7290 million, respectively; in 1990, these were 1.0464 million, 10.8897 million, and 0.7007 million. Compared with 1990, cases increased by 112.81%, prevalent cases by 122.46%, and deaths by 4.04% in 2021.

The standardized incidence and prevalence rates for men in 2021 were 308.68/100,000 and 3,358.06/100,000, respectively, showing increasing trends compared with 1990 (EAPC = 2.32% and 2.48%, respectively; t = 64.23 and 39.67, respectively; $P < 0.001$). The standardized mortality rate increased from 97.13/100,000 to 101.05/100,000, but this trend was not statistically significant (EAPC = 0.05%, t = 0.62, $P > 0.05$) .

In 2021, COPD cases, prevalent cases, and deaths among Chinese women were 2.2076 million, 26.3628 million, and 0.5106 million, respectively; in 1990, these were 1.1146 million, 12.2553 million, and 0.6293 million. Compared with 1990, cases increased by 98.06%, prevalent cases by 115.11%, and deaths decreased by 18.87% in 2021.

The standardized incidence and prevalence rates for women in 2021 were 320.70/100,000 and 3,829.79/100,000, respectively, showing increasing trends

compared with 1990 (EAPC = 2.19% and 2.59%, respectively; t = 25.29 and 33.19, respectively; P < 0.001). The standardized mortality rate showed a decreasing trend (EAPC = -0.77%, t = -3.36, P < 0.01), falling from 91.43/100,000 in 1990 to 74.18/100,000 .

In 2021, the standardized incidence and prevalence rates for women were 1.04 and 1.14 times those for men, respectively, while the standardized mortality rate for men was 1.36 times that for women.

2.3 COPD Incidence, Prevalence, and Mortality by Age Group in China, 1990-2021 From 1990 to 2021, the 25-29 age group showed a weak but statistically significant increasing trend in incidence (EAPC = 0.05%, P < 0.01). The EAPC values for the 30-34, 35-39, and 40-44 age groups were -0.31%, 0.04%, and -0.11%, respectively, but none reached statistical significance (P > 0.05), indicating no significant temporal trends in these groups. Populations over 50 years showed sharp increases in incidence (EAPC > 6%, P < 0.001), with the magnitude intensifying with age, most notably in the $ $80 age group (EAPC = 4.46%, t = 89.92, P < 0.001) .

The age-stratified trend of COPD prevalence showed significant differentiation: prevalence declined significantly in the 25-34 age group (25-29 years: EAPC = -1.52%, P < 0.001; 30-34 years: EAPC = -0.57%, P = 0.045), showed no statistically significant change in the 35-39 age group (EAPC = -0.4%, P = 0.187), increased transitionally in the 40-44 age group (EAPC = 0.60%, P = 0.047), and increased rapidly in those over 50 years (EAPC > 1%, P < 0.001) .

COPD mortality showed a significant upward trend in the $ $80 age group (EAPC = 0.95%, P < 0.001) but continued to decline in those under 80 years (all EAPC < -0.5%, P < 0.001) .

2.4 Predictions of COPD Incidence and Mortality in China, 2022-2032 ARIMA model predictions showed that COPD incidence and prevalence in China from 2022 to 2032 will show upward trends [Figure 1: see original paper], while overall mortality will decline, though male mortality will show an upward trend.

By 2032, the standardized incidence rate for the entire population is projected to reach 409.39/100,000, with male incidence at 419.57/100,000 and female incidence at 430.13/100,000 .

The standardized prevalence rate for the entire population is projected to reach 4,675.48/100,000 by 2032, with male prevalence at 4,468.94/100,000 and female prevalence at 4,979.20/100,000 .

The standardized mortality rate for the entire population is projected to reach 71.39/100,000 by 2032, with male mortality at 112.10/100,000 and female mortality at 77.32/100,000 .

Discussion

COPD is a common preventable and treatable disease characterized by persistent respiratory symptoms and airflow limitation. Without timely intervention, it can lead to pulmonary heart disease, respiratory failure, and even systemic functional impairment. WHO data indicate that China has the highest COPD mortality rate globally. COPD has become a major public health issue, with studies showing that in six cities including Beijing, the direct economic burden of COPD accounts for 40% of household income. In Guangdong, the per capita disease burden for COPD patients is 662,844.60 yuan, with direct economic costs accounting for 35.55%. In rural Yunnan, the annual per capita economic burden for COPD patients is 11,348.88 yuan, representing 72.06% of per capita GDP. As global population aging intensifies, the burden of COPD will further increase. This study, based on the GBD 2021 database, examines the current status of COPD and predicts future trends to quantify disease burden, providing data references for prevention and management strategies and theoretical support for precise, standardized, and sustainable COPD control.

Our results show that in 2021, the standardized incidence, prevalence, and mortality rates of COPD in China were 307.20/100,000, 3,504.57/100,000, and 85.88/100,000, respectively. Compared with 1990, standardized incidence and prevalence increased by 105.20% and 118.57%, respectively, while standardized mortality decreased by 6.8%. Given China' s vast territory, nationwide epidemiological surveys are challenging, so most COPD research uses regional or multi-point sampling methods. A 2007 population-based cross-sectional survey found a COPD prevalence of 8.2% among people over 40 years. The 2018 China Pulmonary Health Study reported a COPD prevalence of 8.6% among adults over 20 years and 13.7% among those over 40 years. These studies confirm that COPD incidence and prevalence in China are increasing, likely due to population aging and environmental pollution.

Previous research found that COPD mortality among residents in Baoshan District, Shanghai, decreased significantly from 2010–2019. The decline in mortality is attributed to improved medical care and enhanced patient awareness and self-management. Additionally, government and healthcare institutions have contributed to COPD control through guidelines such as the "Guidelines for the Diagnosis and Treatment of Chronic Obstructive Pulmonary Disease," "Guidelines for Primary Care Diagnosis and Management of Chronic Obstructive Pulmonary Disease in China,"and the "China Chronic Disease Prevention and Treatment Medium- and Long-Term Plan (2017–2025)," which have reduced COPD mortality through smoking cessation campaigns, air quality improvement, and preventive services.

In 2021, the standardized incidence, prevalence, and mortality rates for Chinese men were 308.68/100,000, 3,358.06/100,000, and 101.05/100,000, respectively, while for women they were 320.70/100,000, 3,829.79/100,000, and 74.18/100,000, respectively. Compared with 1990, incidence and prevalence increased for both

genders, while mortality decreased. Notably, women' s incidence and prevalence were 1.04 and 1.14 times those of men, respectively, while men' s mortality was 1.36 times that of women. Research confirms that women are more susceptible to COPD than men, possibly due to increased global tobacco use among women, exposure to biomass fuels, and biological differences such as smaller lungs and narrower airways that increase sensitivity to tobacco smoke.

Age-stratified analysis revealed a weak but significant increase in incidence in the 25–29 age group, likely related to early exposure to risk factors such as smoking, air pollution, and occupational dust, warranting proactive prevention of risk factors like e-cigarette use and occupational exposures among young adults. The 30–44 age group showed non-significant fluctuations, while those over 50 showed sharp increases in incidence that intensified with age, peaking in the $ $80 age group. This reflects the cumulative effects of aging and long-term risk factors, as well as accelerated lung function decline in older adults, highlighting the need for enhanced COPD screening, early intervention, and chronic disease management policies for the elderly.

COPD prevalence showed heterogeneous patterns across age groups: significant decline in the 25–34 age group, non-significant change in the 35–39 group, transitional increase in the 40–44 group, and rapid increase in those over 50. This differentiated pattern indicates the need for age-stratified management strategies—strengthening early screening and intervention for older adults while implementing primary prevention of risk factors among young and middle-aged populations to curb disease progression. Mortality in the $ $80 age group increased significantly, while all groups under 80 showed continuous declines, underscoring the challenge of end-stage COPD management in an aging society and the need for quality-of-life-oriented comprehensive care for the oldest old. The declining mortality among younger and middle-aged groups validates current prevention strategies, which should be expanded to achieve Healthy China goals.

Overall, COPD epidemiological indicators rise significantly after age 60, peaking in the oldest old, indicating that the elderly are the primary disease burden population. The 2018 China Pulmonary Health Study reported COPD prevalence of 21.2% among those aged 60–69 and 35.5% among those $ $70 years. Age is a known risk factor for COPD, as respiratory system aging leads to physiological decline, reduced pulmonary capillary beds and blood flow, impaired diffusion capacity, and decreased lung defense mechanisms, making older adults more vulnerable.

This study used the ARIMA model to predict COPD trends from 2022–2032. ARIMA is a widely applied time series model with good performance in disease prediction, having been used for infectious diseases, chronic diseases, and cancers. Predictions show that by 2032, COPD incidence will reach 409.39/100,000, prevalence 4,675.48/100,000, and mortality 71.39/100,000. Both overall and sex-specific incidence will continue to rise, while mortality will fluctuate but show an upward trend compared with 2021. Previous research using proportional change models estimated that based on natural trends in risk factors from 1990–2015,

COPD deaths in China would reach 1.0554 million by 2030, with a mortality rate of 73.85/100,000. Multiple studies indicate that China' s COPD burden will increase significantly.

Respiratory diseases led by COPD have become a major factor affecting healthy life expectancy, with 88.5% of deaths in China attributed to chronic diseases, of which cardiovascular disease, cancer, and respiratory diseases account for 80.7%. COPD has become the 3rd–4th leading cause of disease burden and mortality, yet prevention efforts in China lag far behind developed countries. To prevent further deterioration and increased social burden, proactive strategies are needed. First, multi-channel education on COPD prevention and treatment should improve public health awareness and promote healthy lifestyles. Surveys show that in 2014–2015, only 9.2% of Chinese over 40 knew the term COPD, and only 5.8% had relevant knowledge, making education urgent. Second, primary care institutions and workers need enhanced capacity for early screening and intervention of respiratory diseases, with regular training on COPD prevention, diagnosis, and care to improve professional development. Given intensifying population aging, early screening of high-risk populations and graded management are crucial to reduce disease burden.

Conclusion

From 1990 to 2021, the standardized incidence and prevalence of COPD in the entire Chinese population, as well as in men and women separately, showed overall increasing trends, while standardized mortality rates declined. Disease burden increases with age, with those over 50 being the primary affected population requiring focused attention in prevention and control efforts. ARIMA predictions indicate that from 2022 to 2032, COPD incidence and prevalence will continue to rise across all groups, while overall mortality will decline. However, male mortality is projected to increase, whereas female mortality will fluctuate but show an overall decreasing trend. This comprehensive analysis of long-term trends and future burden predictions provides theoretical and data references for COPD prevention and treatment, informing long-term strategies. The findings suggest that relevant institutions and health practitioners should prioritize COPD, focusing on high-risk groups such as the elderly and smokers, and implement effective prevention and control measures to reduce incidence, alleviate symptoms, and lessen the social and economic burden of COPD.

Author Contributions: CHEN Xueqin conceptualized the study, implemented the research, analyzed and interpreted data, and wrote the manuscript; WANG Shihong collected and organized data; LAI Fengxia performed statistical analysis and created figures and tables; ZHANG Jingjing revised the manuscript; CHEN Hao designed the outline; KONG Danli secured funding and provided supportive contributions; DING Yuanlin supervised and reviewed the article and takes overall responsibility.

Conflict of Interest: The authors declare no conflict of interest.

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Note: This study is based on the GBD 2021 database and includes populations under 30 years, but the predictions are more applicable to environments and populations similar to the data source, particularly high-risk groups aged 60 and above and COPD patients in chronic and stable phases. The model assumes stable future trends and is suitable for long-term COPD burden management, especially under clinical conditions with stable disease management and clear diagnostic criteria. The study has limitations: due to restrictions on publicly available data sources, we could not obtain data for individual provinces, cities, or townships; the GBD 2021 database does not provide data on dietary habits, lifestyle, or behavioral factors, limiting further in-depth analysis.

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Note: Figure translations are in progress. See original paper for figures.